MINE MANAGEMENT

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by R. Dawson Hall

Invaluable Aids in
the Quest for Greater
Mine Efficiency

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No 1

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There are as many different human characteristics as there are men in this world and the words which will serve as a corrective of one man's failings may act only to fix another in that unbalanced and exaggerated virtue which is to him a vice. So that admonition scattered indiscriminately is like fertilizer supplied to fields at random; here it may fill a need, there augment an undesirable surplus. With this necessary proviso, I venture to discuss mine management.

The Superintendent and Foreman.

The attitude of the superintendent and his aides is too often not one of coöperation. The superintendent thinks he is nominated to drive, the subordinate imagines that he must expect to be driven, whereas both are in harness together and both owe a common service to the industry. At best the manager is but the lead horse in the team.

It is the duty of the supervising officer to see that he has good subordinates. We frequently hear it stated that a foreman is "all right so long as I keep my eye on him." Such a man is really not fit for responsible employment. A man who has always to be kept in mind keeps the person who employs him so busy that his proper work must be neglected.

The first duty of the superintendent is to choose good subordinates on whom he can rely. In some respects, in some directions, they should be more competent than himself. His chief work should be to advise rather than to direct them and he will do well to take counsel with them frequently.

I remember a foreman who rarely met with his superintendent. The result was that, when they did have occasion to talk, there was always something unpleasant to be discussed, for mistakes cannot be allowed to go entirely unnoticed, and no man fails to make a few. The result was that the meetings became less frequent and misunderstandings arose where coöperation naturally should have existed.

The foreman expected nothing but complaints and seemed to wait until they sprung up before appearing at the office. When something broke or a mule was killed or a man hurt, he had to make his appearance. Not auspicious occasions these. The undertaker, who only appeared at funerals and who thought the world was sad, had nothing on that foreman for one-sided vision.

Confidence and Loyalty.

The underling is generally disposed to keep silent regarding his mine. He will tell his story in his own ex-parte way, but he thinks he

is being pilloried, if you begin to ask questions. He instinctively believes the questioner is his enemy and wants secretly to ask: "What is it, he has on me?"

This attitude must be overcome. From the very first, the idea of coöperation must be inculcated. Not that the inquiries will always be readily received, because a greater fear than that of censure, is that the manager will forbid some pet method of procedure. Coöperation cannot, however, be secured with a man lacking in willingness and ability.

If you have your choice of subordinates, do not choose a man who can do good work only if watched and prodded. And remember there is wisdom in consultation, for the views of the chief are not the only good views though his salary may be the only good salary.

The quality of loyalty is not wholly extinct and the man, who is permitted to advise his chief is usually more loyal than the backbiter who goes around continually grumbling under his breath that the boss is too much of a numbskull to know what is right.

In fact a haughty behavior saves the manager from one private and personal slight and in return he receives fifty libels behind his back. He pays for his dignity in the most valuable coin, in the goodwill of his aides. Moreover he is sure not to get team play and he is apt not to receive that information which will make his own work effective.

The influence of the man in principal authority reaches down to the trapper-boy. If the manager is open to suggestions, so is the superintendent and the foreman can occasionally see the bright idea of a subordinate while the miner can be whipped into line by a piece of honest reasoning.

But when the head man is blind, all are blind and the company is steered headlong to the ditch. In every mine a degree of freedom of thought should be stimulated and more freedom of expression is consonant with good discipline than some martinets would be found willing to grant. For the man who says "I go not" and goes as bidden is better disciplined than he who said "I will" and went not.

The Man Who Owns the Company.

No point of free speech is more objected to in a subordinate than his habit of talking of "our company" as if he owned the president, manager and board of directors. Yet rarely does a young man use this presumptuous expression without being worthy of a raise in salary and a more responsible position.

If every man or boy from the manager who bought the machinery, to the boy who carried oil for it, regarded the organization for which each worked as his own particular company, he would be as loyal to it as he is to his father, and that company would not only secure what dividends were accessible, but would have a number of prosperous and contented employees.

"Our company, our mine, our shaft, our mule barn" even, are the eloquent expressions by which success is assured and we may be sure that

he who uses them is doing the work of a man. Those who use the possessive adjective in the third person, when referring to the company and its possessions, only find the first person applicable to "my time, my rights and my pay."

And that is why the recognition of an employee, by giving him a suitable designation expressing his real office and by entrusting him with all the power which can safely be permitted him, will bring its certain fruits.

I remember a railroad manager who obtained control of a coal corporation and who objected to the number of bosses around the mines. So the weigh-boss who was really in charge of the tipple became the weighman. He got no less pay and perhaps did not miss the title for he still had the control. Even we, white men, sometimes feel a sympathy with the nigger who got a contract to cut props at $20 a thousand, and sublet it for $20.15. It was worth something to him to be boss.

The employee has an interest in the conduct of his work. It would often be as much to him as his pay were it not that every man must have a becoming sustenance while performing his work. Consequently a continued interference with an employee's action which lowers his dignity and belittles his self-respect, deprives him of what he values often even more than his pay.

Working for Honor.

And here we may be pardoned for calling attention to another consideration in the matter of loyalty of employees. Men can only be persuaded to work for honor or money. In most cases, we need some of both. The man who is working solely for his pay is a sorry workman and nobody wants him.

Yet, you hear officials in companies say "Why is he grumbling? he is getting good pay." The man who is working for honor and only gets good pay, may be getting all his contract calls for, but it is hardly likely that the company for which he works is getting what *it* bargained for or what *it* can get for some trifling recognition of the value of an employee.

Half the worthwhile men of today are working largely for the honor of the positions, because the office they hold gives them some purpose in life. We are prone to think that a desire for recognition is undemocratic, and an evil trait. But not less so is the desire to get that same recognition by the accumulation of money.

We are all seeking distinction of some kind, and the man who seeks it for his merits directly is not any more snobbish and undesirable than the man who seeks that distinction by obtaining money, and who thus gets a title to respect which he must carry in common with those who have made money by fraud or obtained it by inheritance.

The Busybody as Superintendent.

The newly appointed superintendent is prone to get busy immediately. He should realize, however, that it is not his office to do any part

of the work of which he is manager. The hardest problem he must face is to avoid meddling. Some men are desirous of filling all the subordinate places themselves, feeling that otherwise the work will not be well done.

The performance of any subordinate task as a regular duty causes the mind to be withdrawn from the paramount necessity of being, not an ordinary supervisor, but a supervisor of supervisors. The cause of the manager's appointment may have been his excellence in the performance of subordinate duties, but his elevation was made in the hope that he would know how to transfer that skill to his subordinates or to select men who are already possessed of such skill.

The first need then of a superintendent is the power to distribute the duties of supervision, the second to choose desirable supervisors, the third to see that the supervision is well exercised. Of course there are other requirements, but they do not include the authority to hire laboring men, the care of the houses and a hundred trivial matters which can best be left to the men on the ground, who being less peripatetic are more likely to be accessible when needed.

Most active men irk at denying themselves an active part in the supervision of a mine; some long to take a hand in its actual operation but this highly creditable desire must be restrained.

Building Up the Staff.

The first time a subordinate makes some decision or gives some order which is not in accord with the superintendent's policy and he interferes, one of two things will happen. The subordinate will either resent the interference or he will be disposed in future to submit every question to his chief. The first man's action is to be judged by the nature of the matter involved and by the character of the man, and action must be taken accordingly.

The second man can only be met in one way; his suggestion that he will submit like matters in future must be positively forbidden. The subordinate must handle every proposition, unless of the utmost importance, entirely alone and in accord with what he knows of his chief's mind and, at least in part, after the dictates of his own judgment.

So sure as the matter is always passed up, so invariably will the superintendent find his days filled with trivial tasks and so certainly will he be surrounded with men of straw. Men who are willing to submit everything to the chief are of extreme value for they show an evident desire to please, which will make them follow closely the line of conduct marked out, but they must not be permitted to give way to the impulse but decide as they believe is satisfactory to their chief.

There are two types of superintendents, the worker and the loafer. Be neither. The average superintendent, not having devolved all his duties on his deputies, has no time to visit other mines, to read his technical paper, meet the traveling experts of the machinery concerns and visit all parts of the mine before they give trouble.

He should forecast his troubles so that they are evaded, not met, and thus they will leave no scars behind. There is no generalship in fighting as a private. When the general is doing the work of a common soldier, the enemy cuts off supplies or destroys the platoon by an enfilading fire. The mere worker is a loser, so is the loafer.

But even the model chief cannot foresee everything, however patiently he may scan the horizon. Consequently the man whose time is entirely at the disposal of the call of the minute or of the problem to be solved is the ideal superintendent.

Scientific Management.

This attitude toward a position results in scientific management. The superintendent, free of daily duties, is free to experiment, to obtain the constants, the units on which his management will be based, to enter up his observations and draw his deductions. Reference to this in detail will follow in its due order.

Such complete devolution of authority will leave little on the superintendent's hands but consultation. To keep active it will be necessary for him to have a set method of investigation. Let him visit his mines with some definite end before him. True, he may see and correct many other things than those he starts afield to consider, but let there be some definite problem for his concentration.

The study for the study's sake is the first element in science. Perhaps we might call scientific management merely a practice or practique, or it might be called an art, but the expression which has taken a hold on the decade, to wit, scientific management, has a real value. It suggests no lighting on solutions, nor intuitively scenting them, but getting at them in the essentially modern way by investigation and experiment.

I am not disposed to enter into the discussion whether the handling of labor by scientific principles is new and whether there is or is not an "ology" of management. The question is largely to be determined not so much by the nature of the discussion as by its degree of complication, the care with which the investigation is conducted and the definiteness of its segregation from other studies. Scientific management is not yet a science, but the three elements just mentioned are combining to place it on that exalted level. Why then should we cavil about mere words?

The scientific manager concentrates on each problem, not because it appears to need solution or presses for an answer, but because it is a problem to be considered in its turn for a complete understanding of the subject in hand. The time to study is not when the occasion confronts you. You may be too busy then; fear of failure and consciousness of past misjudgment may make clear thinking impossible despite all manner of concentration. Frequently the only real success at mental isolation is attained when a man is endeavoring to disguise a blunder or cover up his incompetency. In either case his mind is not so much on management as on his own relation to it.

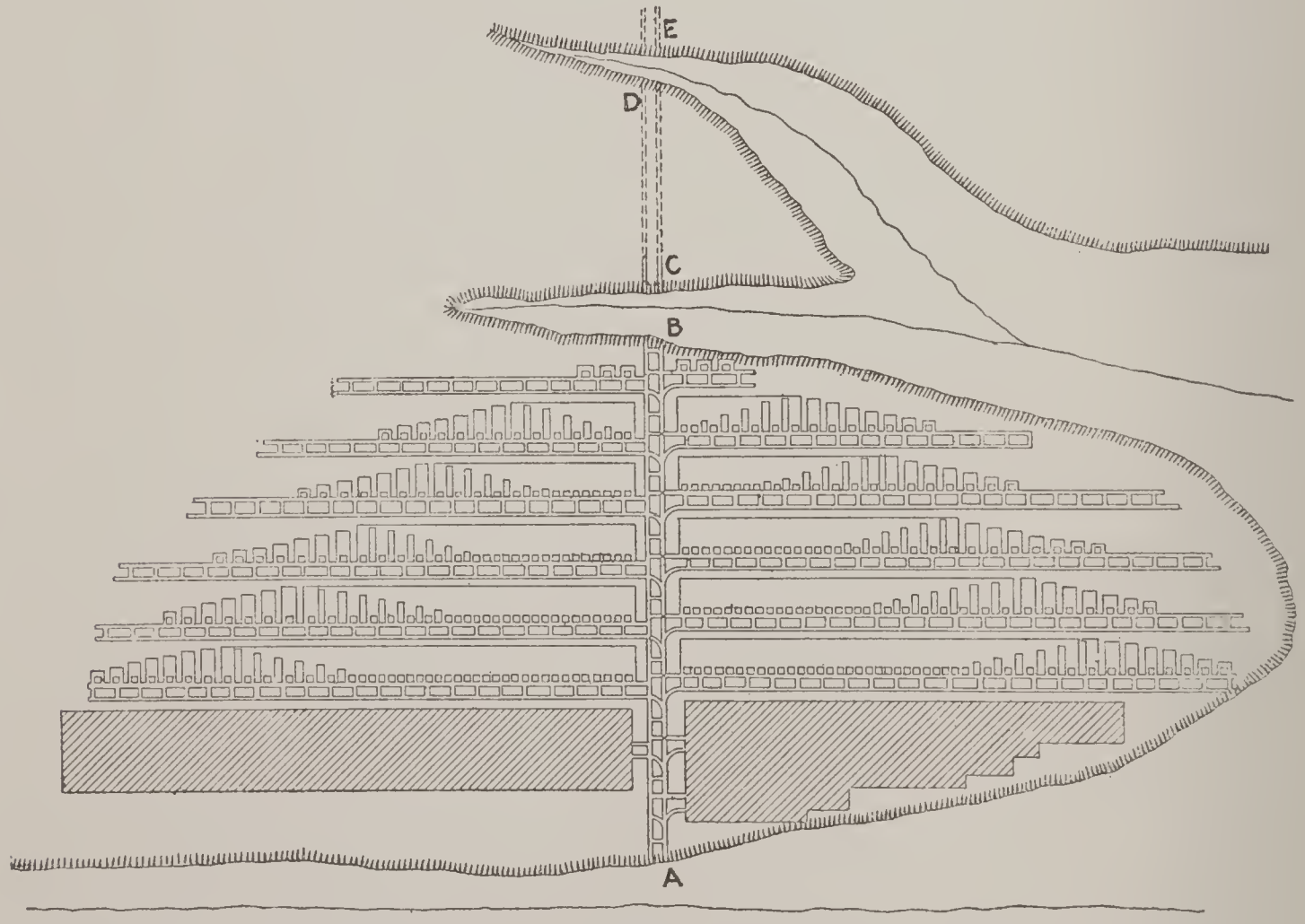
Entering the work of the day, let the manager or superintendent be prepared not to burden himself with the immediate problems of the hour, except where these cannot be shifted, but with a problem which in the future must be solved. This should in general be the necessary attitude of his mind. The applications may be viewed more appropriately later.

Mine Development.

The problems of mine development are solvable by no universal equation. Where the conditions are uniform, the boundaries regular and at approximately equal radial distances from the center of operation and the coal thick, the problems are not many and the main need is for a few radial roads to avoid the right-angled turns occasioned by the rectangular layout of a mine with regular cleavage.

But where the boundaries are irregular and the coal thin, development may be retarded by the prosecution of a system of working which, at first sight, appears far from suicidal. The only way in which to guard against difficulty is to prepare a map which will show the anticipated development month by month.

When such a map was drafted for a certain mine in central Pennsylvania, a strange condition of affairs was revealed. The mine was opened by a drift in a long and narrow strip of coal land perhaps 3,000



The output of this mine suddenly declined because the openings at B, C, D and E were not made till necessity demanded

feet across. A development to 2,000 tons per day seemed possible despite the fact that owing to low coal and excessive wages per yard of heading driven, the rate of entry progress was slow.

The entrymen were disposed to reduce their yardage for fear the company would be inclined to lower the contracted price at the next annual adjusting. It was found that after some 18 months, the tonnage thus reached would fall off owing to the emergence of the main entry from the first strip of land and its entrance into another with the opportunities for development all on one side.

Obviously this could only be met by opening drifts in the dividing valley synchronously with the development of the first mine and stocking the coal meanwhile until the openings met in the first strip of coal territory. By similar methods, in other mines, the future may be carefully foreshadowed by actual computation.

Every yard of heading driven before it is needed for the maintenance of the mine tonnage is so much money unnecessarily invested, so much improvement to be kept in repair and subject to loss, and therefore to be avoided. On the other hand, every care should be taken to avoid the restriction of output which often arises from enveloping crop lines and boundaries.

A Forecast or a Dearly Bought Experience.

Moreover, if by investigation, it is found that a large tonnage is impossible under present conditions (and in how many cropping mines with low coal is this not true?)—then it is not well to put in equipment suited to a large tonnage which cannot be attained. Of course, it may be possible to produce a better result as soon as we clearly realize that in this problem we face the difficulty of all difficulties.

Among remedies may be included the use of machines in headings, the providing of air drills, the purchasing of pumps kept always ready for installation should water be struck, the selection of the best men for those headings which are of strategic importance, double or triple shifts, lowering of headings, multiplication of openings for the creation of a single continuous haulway, the bonus system and preferences in car distribution.

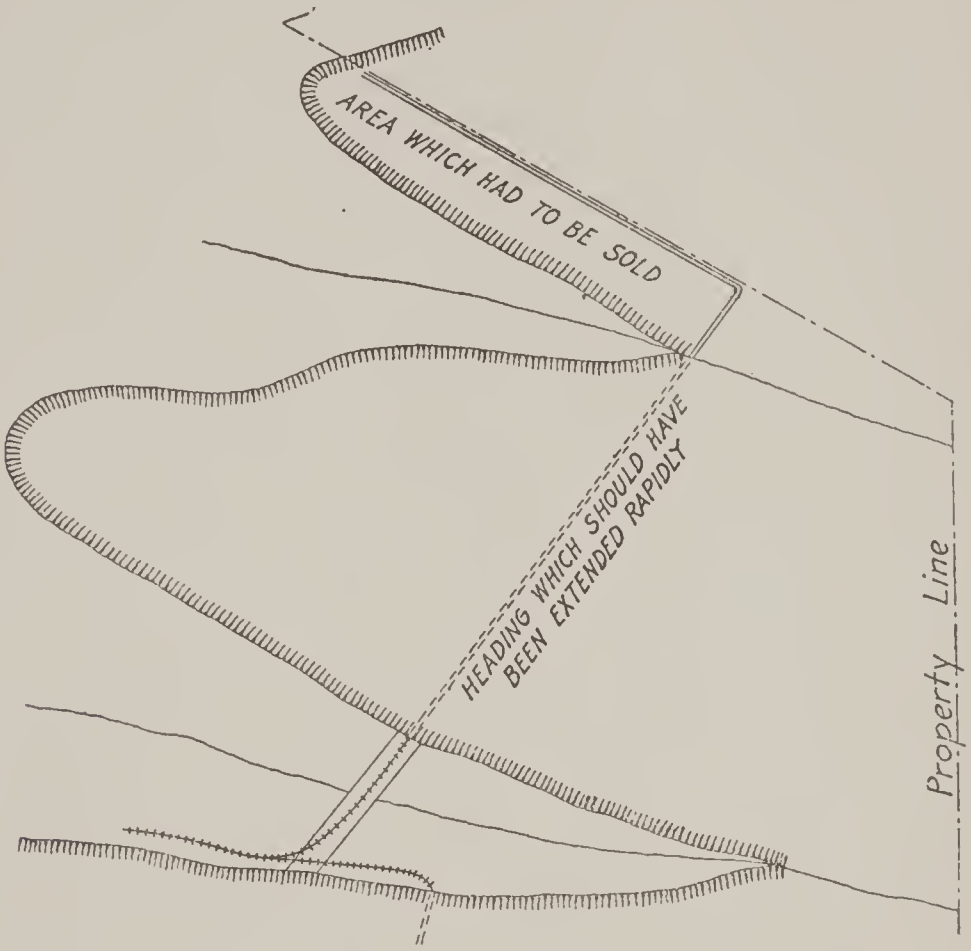
These measures are frequently adopted in the end. But too often they are introduced only after a complete failure to produce results commensurate with the original imperfect forecast of the difficulties to be faced. Attempts are made to avoid such expedients, so that for a long time the equipment works at half or quarter pressure.

Then the solution forces itself upon the management, the fault being laid first on a hundred remoter causes. The new development is then hampered by the fact that promises have not been fulfilled and the mine may never succeed in getting appropriations necessary to provide an output proportional to the original outgo.

But sometimes success attends every effort until some section of the mine is finished. The new section has not been entered, the heading

to be driven to it is long and passes through unproductive territory or maybe in an area so narrow that no tonnage can be expected. In such case, the mine is shut down or tonnage wanes perceptibly.

In one case, we recall, a mine with a large available acreage was closed and in another, a panhandle of coal was sold. Neither course would have been necessary, had a time chart of probable future extraction been duly elaborated and carefully considered.



The main entry in this mine was extended fast enough to maintain tonnage. When the boundary line was reached, an area was found, the working of which held back the closing of the mine, yet was not large enough to make mining profitable

Synchronization.

The problem of synchronization also needs close attention. I have in mind a long heading skirting the crop about half the way. There was, however, a block of coal to the left of some 10 or 15 acres. This was left for some time because it dipped, but at length the headings were driven and the coal extracted.

Meantime the coal coming from the long heading had become considerable and the product from the two conflicted. The haul to the near block of coal was shorter than that to the one worked at the end of the long heading and the time of teams could not be adjusted.

The same problem often occurs with locomotives and often the delay in finishing up one heading will make a regrading of a main haulageway or the moving of a side-track impossible. A definite attempt to synchronize should be made so as to prevent interference in transit and permit the reduction of gathering-trip distances to a minimum.

The synchronization of distances involves the question of grades about which superintendents know far too little. Can you tell how many cars in your mine under normal conditions can be pulled up any given grade; and at what speed? How many can be drawn on a level? What is the tractive force necessary when the cars are running perfectly?

And what percentage of possible efficiency are you approximating? Have you a cross section of the bottom clay under your coal? Do you know how much it costs to lift a cubic yard of each stratum? Can you tell how much saving can be made by any single improvement, in view not only of the delay caused to the unit of traction directly affected, but to other units and to the general output of the plant? Or are you in the habit of guessing all these figures?

Every improvement will cost a certain number of dollars, effect a certain definite saving. Have you figures for both, or are you bound wholly by your desire to spend money or by a longing to save it? Most of our judgments are based not on knowledge, but on the sheerest guesswork.

Unfortunately the uncertain tenure of office prevents superintendents from looking far ahead, and that is one reason why expert advice from outside is to be recommended. The needed treatment of a distant part of a mine may be wholly different from the manner of conducting a nearer section and the plant may need to be laid out for this future. In many cases, the ultimate operations can be guarded without any expense other than that of a little thought and the failure to consider the problems is criminal.

Dollars and Cents.

Most problems of mine management admit of reduction to definite figures. In the rush of business, a manager, who has not divested himself of unnecessary and unsuitable details, has no opportunity even to seek these figures from others. But subordinates should be trained to present estimates of losses, costs and profits, to think definitely and to realize that they are liable to be confronted with their own figures.

Many a mine remains circumscribed by ill-adjusted boundaries because the manager does not show, in definite figures, the loss actually incurred. Shafts are opened sometimes a long way from the center of the territory they serve and the decrease in the output consequent on this fact and the long haulages involved create a certain easily ascertained loss which can be evaluated quite closely. This same argument applies to reservations under farm houses which are almost always purchasable at costs far below what their annoyance will involve.

The cost of coal is the nightmare of the corporation president. Let him pass it to the manager, let the superintendent have it to worry him, let him see that it dogs the foreman, and let him hand portions of it over to his aides. Let every man know what is the cost of his part of the work.

Let the tipple-boss say, "I dump coal for so much," the driver-boss declare, "I haul coal for so many cents," the mule-boss know that "the upkeep of my mule is so much per ton, and so much per mule," and the motorman know what is his running charge per ton and per ton mile.

Furnishing Motives.

Nothing keeps the sense of responsibility more clearly before every man than the knowledge that every misspent hour means an actual loss of money. The average man overlooks that fact. He is idle and careless usually not at all from a dishonest motive. Men are not dishonest as a whole. Exceptional cases are found, but where nothing is risked, one may as well assume that honesty is the rule.

I recall a hardware merchant and master plumber who had six journeymen, who gradually contracted the habit of arriving late in the morning. He wanted to break up the practice and so one day he went into the plumbing shop in high dudgeon, declaring that he had just weighed out 95 lb. of nails to a farmer who had asked for a hundred.

The avaricious agriculturist had, he said, watched the operation and angrily insisted on getting full weight. The journeymen plumbers sided in with the farmer and a hot argument arose, the boss closing his weak and waning defense with a few words assuring his men that he had as much right to give 5 lbs. of deficient weight as they had to give 15 min. of short service.

The argument produced the right effect and the men, for a month or so, came to their work on time. The argument appealed to them that a man who could not sell short weight, could not pay for short labor.

There is apt to be an impression that the company agrees to give a certain amount of pay in return for a given amount of industrial misery, rather than for a fixed quantity of service, which service is handed on in the form of a salable commodity to the public.

Scientific vs. Physical Management.

There are a number of spurs to action in coal mining—cost per ton, tonnage and freedom from breakdowns. A good foreman will keep these before his men, just as a manager keeps them before his foremen. The prospect of being able to make a record is the most stimulating force in a new mine.

In the making of that record all should combine. If the right spirit rules, discipline is almost forgotten. In fact, the martinet rarely has the success which comes, as it were, almost unsought by the man who is not a strict disciplinarian. Even scientific management fails to patch the jarring elements in a mine together as well as they can be harmonized by a body of enthusiastic employees.

Such a faculty of scientific experts can hardly be assembled as can be found in a body of men who have a common end in view, and who know their work and the manner in which it can be effected probably better than any mere expert of business can hope to learn it.

The difficulty with all the form-filling methods of the scientific-management promoters has been the fact that they have usually failed to convince the employee that the investigation is made not to apportion blame, but to provide an opportunity of recognizing merit. Unfortunately in well-organized businesses like coal mining, the union has provided that the award of merit paid to one becomes a fixed and permanent charge on the industry, payable thereafter to the most valueless employee, the operator can at any time be induced, necessitated or compelled to keep at that work.

The Daily Tonnage Cost Report.

Every superintendent should make a daily report of cost per ton. This figure should not be determined only monthly or semi-monthly, even though, only at that time, can it be determined with absolute correctness. We are apt to delude ourselves that the costs will be satisfactory, when the monthly accounting is made and, to avoid the fatal awaking which occurs every time a payroll is prepared, we need to be brought face to face with the costs every day.

At some mines, the foreman is supposed to do this work, but it certainly takes up too much of his time. It is better left to the superintendent's clerk, and then if a copy is presented to the mine foreman every day before the succeeding noon, he has an ever-present goad toward better work, a goad which moreover does not make unkindly feelings between the superintendent and the foreman.

The figures thus obtained might well be allowed to pass down to various under-officials. The clever foreman will balance high costs in one part of the schedule by reductions in another, and will be able to see, for instance, if his increased charge for roadwork is being overbalanced by a decreased cost in haulage and dumping due to the greater output thereby resulting.

The item "Yardage and Room Turning" is usually estimated. A careful man can generally come somewhat closely to it and the foreman should be constantly admonished to estimate this within a half cent per ton. There is a difficulty, of course, in knowing what to do with fixed expense when work is slack.

If figured on a per diem basis, assuming regular work, it will be charged at too low a figure. It is the only fair basis perhaps, but it should always be remembered that a clever superintendent or foreman will pare charges to a low limit when the mines are running slowly. In some cases, the whole of the charges, since the last day's run, are placed on the day of resumption, when the idleness is quite short.

The accompanying form is that used by a coal company in the Middle West.

CONSOLIDATED INDIANA COAL COMPANY

Daily Estimate of Expenses and Local Earnings of Mine No.....at.....Date.....191..

	No.	Hrs. Wkd.	Rate	Amt.	Per Ton
Superintendence					
Hymera office..					
Asst. superintendent.....					
Local office.....					
Top boss.....					
Pit boss.....					
Night boss.....					
TOTAL.....					
Engineering Corps					
TOTAL.....					
Mining					
Machine: Runners, day...					
Machine: Helpers, day....					
Machine: Runners, ton....					
Machine: Helpers,					

	No.	Hrs. Wkd.	Rate	Amt.	Per Ton
Hoisting and loading					
Engineers: day..					
Engineers: night					
Firemen: day..					
Firemen: night					
Engineers' helpers.....					
Trimmers.....					
Weighmen.....					
Cagers top.....					
Cagers bottom..					
Dumpers.....					
Slate pickers....					
Car droppers...					
Unloading rock.					
Screen cleaners.					
Track weighmen.					
Car sealer.....					
Dockers.....					
Check pullers...					
Box-car men...					
Car pinchers....					
TOTAL.....					
Ventilatic					

Summary	Amt.	Per Ton
Outside Material: Rents—Material.....		
Outside Material: Lubrication.....		
Outside Material: Feed used.....		
Outside Material: Repairs.....		
Outside Material: Supplies used.....		
Inside Material: Explosives used.....		
Inside Material: Lubrication.....		
Inside Material: Props and timber used....		
Inside Material: Rails used.....		
Inside Material: Mine cars.....		
Inside Material: Repairs.....		
Inside Material: Supplies used.....		
Superintendence.....		
Engineering corps.....		
Mining.....		
Haulage.....		
Inside labor.....		
Hoisting and loading.....		
Ventilation and drainage.....		
Outside labor.....		
Loss and damage.....		
General expenses.....		
Rolls and deficient work.....		
Yardage and room turning.....		
Total operating expenses.....		
Brought forward this month		

Hand { Miners.							
TOTAL.....							
Haulage							
Stablemen.....							
Boss driver.....							
Drivers.....							
Track layers....							
Spraggers.....							
Greasers.....							
Couplers.....							
Jackmen.....							
Motormen.....							
Trip riders.....							
Team drivers...							
Switchmen.....							
TOTAL.....							
Inside labor							
Fire boss.....							
Dead Work { day.. night.							
Timber men....							
Room boss.....							
Electrician							
Electrician's helpers.....							
Jerrymen.....							
Loading rock...							
Cleaning roads..							
TOTAL.....							

Bratticem							
Water haulers..							
Pipemen.....							
Fan operations..							
Trappers.....							
Gasman.....							
TOTAL.....							
Outside labor							
Blacksmiths.....							
Blacksmiths' helpers.....							
Carpenters.....							
Watchmen.....							
Teamsters.....							
Bit sharpening..							
Roustabouts.....							
Ash wheelers...							
Cleaning up....							
Unloading timbers.....							
TOTAL.....							

Production today.....	
Less boiler coal	
Net production today.....	
Total output to date.....	
Hours worked today.....	
Days worked this month.....	
Days idle this month.....	
Additions and Betterments { Labor.....	
Material.....	
TOTAL.....	

Local earnings	*Expenses*	*Revenue*	*Net Earnings*
Retail coal.....			
Rents.....			
Material.....			
Explosives.....			
Fuse.....			
Blasting paper.....			
Insurance.....			
Smithing.....			
Store commissions.....			
Other commissions.....			
Miscellaneous (itemize)..			
Total local earnings...			
Brought forward this month			
TOTAL TO DATE.....			

In computing "costs per ton" boiler coal tonnage of each day must be subtracted from the daily output.

Correct:.....
Mine Clerk

Analysing Defaults of Tonnage.

Reports should be made daily of any causes for delays. It should be emphasized that in most cases these must not be regarded as excuses. They, one and all, suggest changes in conditions. The foreman should be required to report what he thinks should be done to prevent such delays and even more frequently what has already been done to eliminate them.

In fact, analysing delays is an analysis of causes for decreased production. A delay shows the links which have broken down. If there is a scarcity of coal you are assured possibly that your transportation facilities are ahead of your output. The aim then must be to find more men and more places to put them. It is necessary to know the weakness of the operation, not that a place may be found to locate blame, but to show where remedial work is needed.

When a car leaves the track, the fact should not be reported by the driver without a statement of the exact place. This should be in writing so that the roadmen can see it. If it is in a room, the assistant foreman or rib-boss should know it and see that the miner rectifies the alignment.

If the car is at fault the car repairer should receive it for repair. The car should be marked with chalk by the driver with a large "I" so that it can be sidetracked for inspection.

Nothing would stimulate the force like a report showing cars derailed in rooms, and cars off track in headings. It would be well, also, to record those which derail at room partings, so that if the room switches are defective something can be done to correct or replace them.

Correction not Cure.

My observation has been that the mine foreman usually hears of the derailments and satisfies himself by instructing the drivers or motormen to hustle and make up for lost time. He busies himself to speed up the work of the tipplemen and after the trip has made a record return to the mine, he congratulates himself on his clever meeting of the situation and rests thoroughly content with the prospect till another derailment occurs.

This may happen at the same place and from the same causes. Where it takes place, he rarely learns or cares. He regards himself as the man to meet trouble, not as the man to eliminate it. Needless to say, he is busy from the time the whistle blows till the last car is dumped in the evening.

Many a man, haggard, worn and irritable, is suffering the inevitable punishment resulting from half measures, the removal of the symptom rather than the working of a cure. Such men are to be pitied. They think their work should be judged not by its outcome but by the miseries it entails and they cannot understand how, after working both by day and by night, they are not entitled to reward.

Such a form as that following is suggested for recording derailments:

THE BIG LUMP COAL COMPANY

DERAILMENT REPORT

Date_____ Derailments in_____ end of mine Mine No_____

IN ROOMS AND PILLAR WORKINGS						IN HEADINGS							
Room No.	Heading	On Straight Track	On Partings	Signature of Driver or Check Number	Fixed	Heading	Room Opposite	On Straight Track	On Room Partings	On Heading Partings	Due to Dirty Track	Signature of Driver or Check Number	Fixed
Total						Total							

Remarks: (Drivers will here note cases of low or bad roof also where track is in bad condition).

Remarks: (Drivers will note where track is bad and where covered with water).

Signature of assistant foreman_____

The signature of assistant foreman is placed here to show that he has noted the derailments reported and had track defects repaired where marked "fixed."

Signature of assistant roadman_____

The signature of assistant roadman is placed here to show that he has noted derailments reported and had track defects repaired where marked "fixed."

It should be carefully explained to the drivers that this report is intended to enable the management to see what trackwork is needed and to aid in the placing of that work where it is most in demand. But it should be remembered above all that such reports are self-operative. It is a painful truth that unless facts are brought out plainly by statistics the average man will not heed them. The very record makes the men whose deficiencies are recorded anxious to amend them.

The Report Is a Self-Operating Restraint.

It would be well if every coal and rock car were marked by a gatherer with a special check, so that each driver could tell how many cars he hauled. Of course, some are able to make more gathering trips than others, some have roads over which more cars can be hauled and some have a difficulty in getting cars, but as these differences give opportunities for shirking, it is well to keep each man's record if only to stimulate him to report to the authorities some way in which he may be enabled to perform a larger service.

At the side-track, a watch should be kept for the laggard and a record should be made of the loss of time, his slowness causes. Then care should be taken to discover why he is slow. He may have a slow mule or a hard run. In the first case it would be well to transfer a driver with his mule, representing the change as a chance for the new driver to show what he can do.

If the road is heavy or the grades are steep, a calculation of the cost of making the improvement can be balanced against the loss of output in the mine and if the improvement would pay, the change can be effected. The transference of the driver will enable the foreman to compare the records of each man and make his plans accordingly, recalling the fact that the mule may be at fault.

The practice of keeping records is on the whole the surest principle of efficiency. If you have observed, you have always laid out for yourself at least a half more work than you have been able to accomplish. If then you record the day's doings you will find that they do not nearly measure up with the amount of output you regard as a day's work.

The filling of a blank at the end of the day is therefore nearly always a self-criticism of inefficiency and makes every one who fills a report more diligent than he would otherwise be. In some companies such reports are made even by the engineering force. Whether they are ever scanned by the management is doubtful, but they certainly tend to speed the work. The product even then often seems dolefully unequal to the time expended.

Coal Sizes.

A close watch must be kept on coal sizes to meet the present market. It is true that it would be better if the public was prepared to demand fine coal only. But it is not, and the percentage of smaller sizes should be worked out whenever any size is being made. When a slack car is put under the screens, the fact can be noted and the total dumpings thereafter, till the car is loaded, can be totalled. The weight of the car-

load being received from the weigh scales, the percentage of slack can be determined. Unless this is known, one cannot tell what combination of sizes pays best and whether the percentage of slack is on the increase.

Experiments made in a few rooms worked according to different mining systems, shot with varying charges of powder, from holes at different locations arranged at variant angles and cut to different depths by different machines, undercut in the clay or in the coal, with side shearing and without, will prove how coal can be mined with minimum breakage. Then again, the effect of these many methods with powders of varying rapidity of action should be determined.

Everyone has vague ideas as to which methods of working will reduce the slack most, but quantitative studies have not been made and they are needed for almost all kinds of coal. If the difference in cost were only a few mills, the investigation would be purely academic, but with slack worth only 10 or 20 cts. a ton throughout much of the year, and lump from $1.25 to $1.50 in the same region, a definite investigation of the percentages of each obtainable with certain systems of working should be made, and the result should be carefully considered in connection with the cost of operation under each system. Some concerns have found it advisable to excavate the underclay only.

It seems probable that it would pay to screen and weigh the output from certain rooms and pillars under sample methods of operation, taking the percentages of sizes from the undercut and the shot coal separately. It is well to call attention to the fact that the popular judgment as to the amount of fine slack caused by the puncher and chain machines respectively was usually found to be in error. The correct results can be found in the bulletin on the Explosibility of Coal Dust, issued by the Bureau of Mines.

Economy in Timber.

Our lack of scientific method is observed in our timbering. We buy props usually without reference to the material from which they are made and in places where fungus growths have been started, we place new timbers untreated to receive the spores of the fungi. We have not even experimented on some wash which would kill the growths and sterilize the old timbers.

But in close line we put diseased and healthy timbers without any attempt to remove the infection from the first or to immunize the second. Nor do we care whether the timber is cut when the sap is up or when it is down. The spore-laden air is passed without thought through new workings to infect new timber.

We do nothing to record the life of the various woods. Of course in the case of props which we do not expect to recover as the timber is soon destroyed and does not have to be replaced, the length of life is not of importance, but in the case of timber sets which cost labor as well as timber to replace, the value of investigation is not to be overlooked.

Another matter which is entirely unnoticed is the strength of the draw-slate. In many mines, because of excessive and ill-judged shooting,

the draw-slate is weakened or broken. It thus is dangerous to the miners and may need to be taken down and gobbed. In other cases the weakness of the draw-slate may make it hard to use types of machines requiring much free space before the face. A few experiments on the different methods of setting shots may eliminate much danger, trouble and limitations in the type of machines used.

Prevention of Waste.

There are many mines where the inventories are made with extreme carelessness. The rail is scattered about the mine, part under water perhaps, part at the faces of long, idle and perchance low rooms, other parts in back headings, only to be measured after a long trip over rock and through water; therefore an inventory is not demanded. The foreman and his assistants are busy and so the rail estimated is the amount recorded as on hand last year plus that bought in the past 12 months.

As this system is repeatedly adopted, the record gets yearly more fictitious. Perhaps, however, the mine boss sets two roadmen to measure the rail and knowing how much there should be, adds to their figures enough to make the balance. In which case the company loses the buried and corroded track as well as the time occupied by the roadmen in measuring the rail, yet all appears well.

The inventory of the rail should be taken by the chainmen of the engineering corps or by independent men who can be relied on to turn in the lengths thus measured. They should report how much is under water, how much is loose track and how much is rail spiked to ties but not forming a definite part of any roadway. There should be no estimation. Rail under water and not measurable is often so corroded when redeemed as to be valueless.

The loss of iron rail, ties and props in modern mines is immense. Especially is rail lost, where rooms are allowed to stand partly or fully driven. If rail is not supplied in large quantities a man who needs a few lengths will withdraw what he needs from near the mouth of the room. He will not be willing to go to the far end to drag out the rails and these lengths remain in. As the rooms are idle, the foreman does not visit them, or indeed any of his aides.

The men who may find the neglected track are the chainmen of the engineering corps when making the monthly, six-weekly or six-monthly survey, whichever is customary. They should note the rails in a book and report to the superintendent direct. They should also save all rails which are in immediate danger of loss from caves. In well-managed bituminous mines, room-and-pillar workings do not remain idle for any cause, but there are more mines where pillars stand for months than there are where the work proceeds methodically.

The props wasted form a most important item and a report on these would reduce that loss. The miners are frequently negligent and receiving more than they need, leave them lying in piles where the roof

will fall on them. In some mines not a few car loads are lost in just that manner.

Heading Prices.

The headings should also be measured by the engineering force and the prices set should be as nearly standard as possible for a given size of heading. As soon as a variation is allowed, there is no end to the causes for more discrimination, and continual discontent arises. The fussing could nearly always be prevented if the management instead of paying extra yardage prices would put the money into the improvement of the conditions of working.

Pumps, sumps and mining machines should be provided in all wet places. For extra hard bottom, plugger drills should be supplied wherever compressed air is available. Then, though the entryman might have a less agreeable time than in a dry heading, he would get his daily stint accomplished and would be able to make his wage despite the inconveniences. For often the allowance made him for the incompetence of the management and for the shilly-shally delays in providing the wherewithal to remove the water is not sufficient to recompense him on the basis of a day's work for a day's pay, all the extra labor and added discomfort having to be thrown in.

In the issue of *Coal Age* of Jan. 4, 1913, A. J. Reef discusses the question of scientific management and his remarks are quoted here at some length:

> No particular part of scientific management is new; time-and-motion studies were made in industries a hundred years ago; profit sharing is nearly fifty years old; but the scientific spirit in management which applies this principle of transference of skill to all activities in the industry consistently is at least recent.
>
> Can we apply it to coal mining? The laying of a room switch on an entry is an oft repeated operation and so worth considering. How long does it take a track-layer and helper to lay one? Some managers may know. How long *ought* it to take them to lay one? I doubt if any of them know, and necessarily under ordinary operating practice they cannot know, because the conditions are so variable. The men may have to cut a rail to put in the frog or they may not. They may have to carry their tools a half mile to the job or not. They may have to wait for materials to be delivered or not. Laying a room switch is not a standard operation.
>
> #### What is meant by a Standard Operation
>
> The first step in labor-saving management is to make it one. Lay the main-line track so that the joints will come right for the room frogs. This will of itself partially standardize the laying of the entry track. Give the track-layer a schedule when he reports for orders in the morning, to cover his work for the day so that there is a minimum of moving between jobs.
>
> Knowing how much moving there is to be done a definite time allowance for it can be made. See to it that the extra driver on the preceding day or night shift has hauled to the same schedule of places the track materials needed at each. Then so far as the variables mentioned are concerned the laying of that room switch is a standard operation.
>
> Then begin a time-and-motion study and decide and formulate in writing the best method of doing it. Determine a reasonable time to do it by this method; teach your track-layer that method until it becomes habit. Make out a schedule for him for the day based on this determined time, and the moves to be made, and by means of a bonus payment for performance according to schedule keep him up to such performance.
>
> Right here an attendant or incidental advantage is manifest. The workman of course cannot expect to equal that schedule and obtain his bonus unless conditions are up to standard and a spur to the management to keep them so is thereby automatically provided.
>
> #### Not All Operations Can Be Standardized
>
> Admittedly there are many operations in coal mining which cannot be standardized even though oft repeated. Thus, although the basic idea cannot be carried to completion, some careful study and experiment may even here prove helpful.
>
> If the making of the time-and-motion study seems inexpedient or if it should develop that the present method is the best that can be devised, advantage may still be taken of the knowledge that can be obtained of a standard time in which the work should be performed. In this way a schedule of daily tasks may be intelligently made up and used, without any bonus system.

This will afford an easy method of detecting any soldiering on the job. With conditions really made standard and the schedule intelligently made out, based on what a man ought to do, the superintendent will have a right to insist on the schedule being completed.

Many minor points in management which can be used will develop from the attempted application of scientific management even though it be found that the system as herein outlined is not applicable in its entirety to all the various operations of the industry.

The great essential to success in applying scientific or labor-saving management lies in the scientific, experimental attitude of the managing forces toward their problems, and making all the activities of the industry their study.

Employment of Outside Experts

A word as to the employment of experts. Scientific management is not something that can be grafted onto an industry by an outsider. It begins in the spirit of the management forces, and belief in it and enthusiasm for it must reside there continually, if its application is to succeed. Nevertheless an outsider, granted managerial ability, coming fresh to the problems of the particular industry, can frequently see far more than those who are in it every day. His point of view is different. Also the work of making time-and-motion studies is best done by one with special training and their results are best evaluated by one with experience in using them.

The whole idea is so big that its ardent advocates seem unduly enthusiastic and from some of their writings one would imagine the movement a cult or religion. Like every new movement with worth it has its fakers; but these things should not detract from the real value in "labor-saving management."

Safety.

In these days when the question of safety absorbs almost all other problems of management, no treatise of this kind is complete without some reference to the subject. We shall soon arrive in the United States at the time when it will not be necessary to question which is the right method of estimating the death rate—by the number injured per ton mined or per thousand employed—for our death rate by any method of computation will be the least of any country in the world.

Certain sections, rapidly developing where the dangers were all unknown have now been operating long enough that an understanding is being reached of the dangers to be faced and of the needed precautions to adopt in them. In some foreign countries, new fields have been recently developed and new dangers have had to be faced. The solutions are not sought out till a series of disasters have pointed out the peculiar dangers of those fields.

We might mention the outbursts of carbon dioxide in the fields of Southern France, the fire-striking phenomena of the pebble roofs of British Columbia, and the menacing gob-fires of the deep workings of Yorkshire. The aridity of Colorado, the extreme proneness of the dusts of Oklahoma to explode are local features for which cures are being diligently sought.

The Work of the Schools.

But as falls of roof are the most important menaces of America, our death rate will only be reduced by diligent care of this problem. Our public schools will take up the question of caution against accidents and will solve it for the future generation. The management of mines would do well to get a short course on the subject in all the schools. There is no reason why the problem should not be made interesting to boys and girls of ten or twelve years of age.

It is well to enlist the coming women of the commonwealth for the women's recommendations will be far more potent than the men's and

they will put a stigma on laxity far quicker than can all the efforts of the operator, who, while wholly disinterested, is considered always to be subserving his own private interests. It is to the teachers we must look for safety training and I would urge the operator and manager to use quietly their influence with the teaching staff to foster the training of the young in the care of personal safety as also in the proper use of the tenement in which he lives and in the maintenance of decent home surroundings.

The Sentiment of the Mineworker.

But we cannot wait for these children and every effort must be made by institutes and illustrated lectures with moving pictures to get the present miners to be more careful, and to realize that it is not the operator alone who is his brother's keeper. The miner's work in the cause of safety will be more felt when it is once exerted than all the work of the operator. And the sentiment that the work of safety is rightly a duty of every miner will be quickly spread by the first aid organizations which will prove eventually as effective in preventing accidents as in tending the injured.

The managers have formed their judgment of their men too largely from the black sheep in the mining flock. Because these men have chosen to misrepresent all the welfare work of the coal companies, there is no reason for believing that the instincts of gratitude and loyalty are dead. It is hard to keep one's faith when all the men in a colliery drop their tools at the behest of the worst man in the employ of the company, to reinstate a man who often is not fit to associate with the other men in the employ of that corporation. But we must persevere in our confidence that good men are still to be helped and ready to help and before long will make their presence felt.

The industrial trusts at their first forming were utterly indifferent to the needs of the public, the word "rapacious" fitly stigmatised them. But we are learning slowly to associate the name of "trust" with good works, so much care have amalgamated interests taken to promote the safety of the employee, his physical well-being and equal dealings with all purchasers at all times.

The labor trust also is learning. The violence of the early Knights of Labor has been replaced by the comparative orderliness of the modern union. This order and responsibility is far from perfect and among the foreign element a new body of disorderlies has arrived, but still one cannot refuse to see that on the whole there is progress, and to hope that the false leaders will year by year find that the rank and file will not be led to repudiate contracts and indulge in disorder.

Safety Committees.

The United States Steel Corporation has introduced safety committees into all its mines. Three men are paid by the Company to visit all parts of the workings and report on unsafe conditions. They do their work well; they feel honored by their appointment; they can see dangers

which are not appreciated by the management till they are pointed out. Everything is viewed from a new angle by men who are well acquainted with the work.

The same method is followed in England and New Zealand, but the impulse is bad. It has the law behind it. The men are official fault-finders for they are appointed by the Union. A sense of over-importance on one side is balanced by a sense of resentment on the other. In contrast, the United States Steel Corporation finds that the committee which it voluntarily appoints at the mills and in the mines is a complete success. It is worthy of the adoption of other companies and in these revolutionary days I should not be surprised to see that enterprising organizations form commissions of efficiency and lead their men to develop new methods of saving money and labor as well as life and limb.

You have men in your employ whose every impulse is bad, but there are men who have a desire to do constructive work and have a clear knowledge of good citizenship. Give them a chance to help. Encourage them by the recognition of the company. Such men have little enough honor among the undesirable men in your employ.

Publicity and Safety.

Probably there are few men in managerial positions at our mines, who realize how incompletely their underground workings are often inspected by the men who are paid for that work. The miners and other employees continually wink at the dishonesty of such unfaithful guardians of their safety because, as they express it, they are not paying these men and it is none of their business to see that they fulfill their trust.

The logic of this stand cannot be fathomed. They might as well claim that the store company's clerk who neglects to forward their purchased goods is employed by the company; hence they do not care whether or not their orders are filled. Despite the energetic campaign for safety, one is obliged at times to question whether the sentiment has extended to the rank and file of the mine workers.

I have spoken of reports. If they promote efficient work, they will promote safety. But there is little saving grace in a report which is written in a book, the book closed, pushed into a desk, the desk locked and the whole shut up in an office.

When the foreman, assistant foreman, rib and fire bosses have made their rounds let them make a public report nailed up where everyone can see it. If the report says that certain rooms were visited, you may be almost sure that the statement is true for the report is set down at once when the memory is clear, it is scrutinized by the men who know whether it is true or not. See that the language is not ambiguous.

A report so posted will make all the men careful to do their whole duty as required by law. There is something disconcerting in wandering day by day up and down rooms and through crosscuts and the memory of the evening reports will make the laggard less indifferent, less prone to spend his time swapping stories with the mine wit, for unfortunately there are some of these talkative ne'erdowells in every "diggings."

The following shot-firer's report is part of Samuel Dean's paper published in *Coal Age,* Nov. 30.

THE VICTOR-AMERICAN FUEL COMPANY

Delagua Mine,.....19....

SHOTFIRER'S DAILY REPORT

District of mine.....

Time first shot fired?..... Time last shot fired?.....

Number shots examined?..... Number tamped?..... *Number fired?.....

Number of shots condemned, reason why, and where located?.....

.....

.....

Did you fire any shots on main haulage roads back from the face?.....

Number of missed shots, where located.....

.....

.....

Number of blown out shots, where located, and cause of blow out?.....

.....

Did you use a wooden tamping bar for tamping all charges?.....

Did you find anyone in the mine during the time you were firing shots?.....

.....

Did you find any miners with detonators in their possession?.....

Did you examine all the places again, with the aid of a safety lamp, after you had fired the shots, and leave your initials in chalk on the face where the coal had been shot down?.....

Did you fence off all missed shots?.....

Is your safety lamp clean, and in good condition?.....

Did you find any gas in the working places?.....

State the correct time at which you left the entrance to the mine?.....

State here any further remarks you wish to make.....

.....

.....Shotfirer

*As none but permissible powders are now used at these mines, it is no longer necessary to state the number of shots containing black powder, dynamite or permissible powder as was formerly the rule.—[Editor.]

The Objection to Publicity.

It is needless perhaps to point out that there will be much opposition made by mine foremen to an open publication of the inspections they have made, directly or by proxy, and it is but just to say that there are many foremen who, resigning all their economic duties, could not fulfill the letter or even the spirit of the law. Some are indeed not anxious to visit the working places with due regularity. Some are so cumbered with other duties that they cannot.

Many are unable, not so much by reason of the intrinsic difficulties, as by their lack of the powers of devolution and by their habit of solving problems only in part. Thus they can trust nothing to subordinates and cannot rely on any part of the mechanical equipment of the mine to run

without ceaseless watching. Another fault is their habit of not concentrating their work. There are 50 men here and 50 there; and the distance between them may be a mile to three miles.

This may be some advantage where there is gas but in such cases, as a rule, more provision is made for inspection. But in non-gaseous mines the foreman is on a perpetual tramp and having walked himself sore, finds at the day's end that the law is by no means complied with. No wonder he is the first to violate the rule not to ride on the cars. He is expected to go several times on foot from the tipple to the mine face and back, a distance of perhaps a mile, and he is required to make the legal visits as well. This is too common in small mines and not unknown in large ones.

Despite this unreasonable requirement, too often he is supposed to do his work satisfactorily without a telephone. If the tipple is 200 ft. from the office, a telephone joins the two, but if the mine face is a full mile or a mile and a half underground, the foreman is supposed to keep both ends of his operation moving at full capacity without the aid supplied to the most ill-equipped office.

Of course this only applies in part to large mines where an outside foreman and two or three assistants can be found helping the underground foreman, but in a limited degree it is true of many of our largest workings, and in almost all the small mines the condition is precisely as sketched.

Before starting the practice of publishing the reports of all the mine officials, it would be well to see that it is practically and at least physically possible for them to comply with the law. If the supervising force is not adequate, additional help should be employed to fulfill every legal requirement.